Decision Rationale

Total Maximum Daily Load for
Fecal Coliform for Dodd Creek

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDL for fecal coliform for Dodd Creek. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDL is designed to implement applicable water quality standards.
2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDL considers the impacts of background pollutant contributions.
4) The TMDL considers critical environmental conditions.
5) The TMDL considers seasonal environmental variations.
6) The TMDL includes a margin of safety.
7) There is reasonable assurance that the TMDL can be met.
8) The TMDL has been subject to public participation.

II. Background

The 14,442 acre Dodd Creek watershed is located in Floyd County. The TMDL addresses a 15.41 miles of impaired stream segments. The 10.36 mile segment of Dodd Creek runs from the junction of Routes 710 and 714 to Dodd Creek's confluence of the West Fork Little River. The TMDL also addresses West Fork Dodd Creek, from its headwaters to its confluence with Dodd Creek. Pasture and forested lands make up roughly 97% of the 14,442 acre watershed.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 2.62 miles of Dodd Creek as being impaired by elevated levels of fecal coliform on Virginia's 1998 Section 303(d) list. Dodd Creek was listed for violations of Virginia's instantaneous

fecal coliform bacteria water quality standard. The listed section was extended to 15.41 miles in the 2002 Section 303(d) list and included the West Fork of Dodd Creek. The TMDL was developed to address the entire 2002 listed segment, which includes the 1998 Section 303(d) listed segment as well.

Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA had been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth adopted the e-coli and enterococci standards in 2002. The Commonwealth will use the new indicator species criteria to determine impairment when a total of twelve samples have been collected with the new indicator species.

As Virginia designates all of its waters for primary contact, all waters must meet the current fecal coliform standard for primary contact. Virginia's standard applies to all streams designated as primary contact for all flows. Through the development of this and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the fecal coliform standard. Thus, many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the affected streams. The Dodd Creek fecal coliform TMDL did call for the reduction of fecal coliform loadings from wildlife in-stream.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. The first phase of the implementation will insure that the instantaneous standard is not violated more than 10% of the time. Phase 1 of the Dodd Creek TMDL calls for the elimination of all failing septic systems and straights pipes and a 77% reduction in the direct deposit of fecal coliform into the stream by livestock. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. The Commonwealth has indicated that, during Phase 2 it will evaluate the following items in relation to the standard. 1) The Commonwealth may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated as primary contact for infrequent bathing. 2) The Commonwealth will also investigate incorporating a natural background condition for the bacteriological indicator.

After the completion of Phase 1of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model or the Margin of Safety

(MOS). In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted.

Dodd Creek identified as watershed VAW-N20R, was given a high priority for TMDL development. Section 303(d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the state where technology-based and other controls do not provide for the attainment of water quality standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to Dodd Creek, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from the land. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream, failed septic systems and straight pipes, and wildlife in-stream.

Table 1 - Summarizes the Specific Elements of the TMDL.

Segment	Parameter	TMDL	WLA (cfu/yr)	LA (cfu/yr)	MOS (cfu/yr) [1]
Total	Fecal Coliform	3.41E+14	4.16E+11	3.37E+14	3.73E+12

1 Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a fecal coliform TMDL for Dodd Creek. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality standards and designated uses on Dodd Creek. The water quality criterion for fecal coliform is a geometric mean 200 cfu/100mL or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-day period, most of the samples are measured against the instantaneous standard. Based on the water quality data collected from Dodd Creek it appears as though the violations of instantaneous standard occurred during both wet and dry weather events. Since the HSPF provides the modeler with hourly concentration values, the model was run to determine compliance with the geometric mean standard.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to Dodd Creek will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Data used in the model is obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc.. The model then combines all the data to determine the hydrology and water quality of the stream.

A “paired watershed” approach was used in the hydrology calibration for Dodd Creek. A “paired watershed” approach was used because there was insufficient hydrology data on Dodd Creek. In a “paired watershed” approach, the modelers model the hydrology of a stream with a long term hydrologic record (Tinker Creek) that would have a response similar to the watershed being studied (Dodd Creek). In determining if the response would be similar the modelers look at the similarities of the watershed. The land uses, soil types, and the physical characteristics of the two watersheds were determined to be similar.

Tinker Creek, which is approximately forty-five miles from Dodd Creek was the "paired watershed". Tinker Creek was calibrated to USGS flow gage 02055100 located near Daleville, VA. The average daily flow from this gage between January of 1990 through January 2000 was between 0.59 to 454 cubic feet per second (cfs) with an average flow of 12.9 cfs. Data from 1993 through 1998 was used to calibrate the model. A synthetic precipitation data set was developed by combining precipitation data from Covington Filter Plant with data from Roanoke Regional Airport. This was done because data from either one of the stations alone was unable to explain the flows at the gage site. The precipitation data from the stations was distance weighted and summed. The Roanoke Regional Airport weather data was used to model Dodd Creek.

The calibrated model for Tinker Creek adequately replicated the observed conditions. The errors documented between observed and simulated flows fell within the acceptable range as determined by the HSPF Expert program. Error statistics compared the total flow volume, the volume of the lowest 50% of the flows, the volume of the highest 10% of the flows, the storm flow volumes, the seasonal flow volumes, the low flow recession, and the summer storm flow volume between the observed and simulated data.

The model was then run using a completely new weather data set and compared to the observed conditions. This is referred to as the validation process, which determines how well the model duplicates flow conditions. During the validation phase, the model parameters are held constant. Data from October 1999 through September 2000 was used in the validation.

After validation, the hydrologic model was transferred to Dodd Creek for water quality modeling. The water quality component was modeled to the monthly samples collected at the DEQ ambient water quality monitoring station 9-DDD004.64. A total of 45 samples were taken from this station from1988 and 2001. Figures on page 4-31 and 4-32 of the TMDL report illustrate the water quality calibration and validation respectively. It is important to remember when viewing these figures that the observed points are instantaneous concentrations while the simulated data displays the daily average. EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained on Dodd Creek.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based precipitation driven nonpoint source areas, directly deposited nonpoint sources of fecal coliform (cattle in-stream and wildlife in-stream), and point sources. Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal coliform load can be found in Table

1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Waste Load Allocations

Virginia has stated that there is one point sources discharging to Dodd Creek. The facility discharging to the creek is the Floyd Sewage Treatment Plant (STP). Floyd STP has a design flow of 150,000 gallons per day and a permitted effluent concentration of 200 cfu/100ml. The facility chlorinates its effluent and monitors the total residual chlorine (TRC) in its discharge. The TRC concentrations in its effluent ranged from 0.6 to 1.1 milligrams per liter. Using this data it was determined that the facility would be discharging 2 cfu/100ml. This concentration was used in the calibration and validation modeling, the permitted concentration of 200 cfu/100 ml was used in all of the allocation scenarios. The WLA can be determined by multiplying the design flow (150,000 gpd) by the permitted concentration (200 cfu/100ml) on an annual basis.

EPA regulations require that an approvable TMDL include individual waste load allocations (WLAs)s for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Facility	Permit Number	Existing Load	Allocated Load
Floyd STP	VA0025992	1.14E+9	1.14E+9

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the Dodd Creek watershed. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants and toxicants[3]. HSPF uses precipitation data for continuous

[3] Supra, footnote 2.

and storm event simulation to determine total fecal coliform loading to Dodd Creek from a variety of land uses (residential, commercial, pasture, farmstead, and forest). The total land loading of fecal coliform is the result of the application of manure, direct deposition from cattle, other livestock and wildlife (geese, deer, etc.), the deposition of fecal coliform from failed septic systems, and fecal coliform production from pets.

In addition, VADEQ recognizes the significant loading of fecal coliform from cattle in-stream, straight pipes, and wildlife in-stream. These sources are not dependent on a transport mechanism to reach a surface waterbody, and therefore, can impact water quality during low and high flow events.

Table 3 - LA for the Land Application of Fecal Coliform

Land Use	Existing Load(cfu/yr)	Allocated Load(cfu/yr)
Forest	1.60E+12	1.60E+12
Low/Medium Density Residential	1.17E+13	1.17E+13
Pasture/Hay	2.87E+14	2.87E+14
Unimproved Pasture/Hay	1.36E+13	1.36E+13
Row Crops	5.48E+10	5.48E+10
Commercial/ Industrial/ Transportation	5.46E+10	5.46E+10
Farmstead	4.41E+12	4.41E+12
Failed Septic Systems/ Straight Pipes	3.62E+11	0.00E+00
Direct Deposition from Cattle	1.58E+14	0.00E+00
Direct Deposition from Wildlife	4.81E+13	1.78E+13
Total Load Allocation	5.25E+14	3.36E+14

3) The TMDL considers the impacts of background pollution.

A background concentration was set by determining the wildlife loading to each land segment.

4) The TMDL considers critical environmental conditions.

According to the EPA regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Dodd Creek is protected during times when it is most

vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[4]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum. These critical conditions ensure that water quality standards will be met for other than worst case scenarios.

The sources of bacteria for these stream segments were a mixture of dry and wet weather driven sources. Therefore, the critical condition for Dodd Creek was represented as a typical hydrologic year. Since the stream was modeled to attain the geometric mean standard and base and low flow events occurred far more often then wet weather events, it was essential that the standard be maintained during these flow periods. Therefore, base flow conditions were the more critical period.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis effectively considered seasonal environmental variations. The model also accounted for the seasonal variation in loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The margin of safety (MOS) may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL.

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[4]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

Virginia includes an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL. This would be considered an explicit 5% margin of safety.

7) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDL in its current form is designed to meet the applicable water quality standards. However, due to the wildlife issue that was previously mentioned, the Commonwealth believes that it may be appropriate to modify its current standards to address the problems associated with wildlife loadings. It is believed that because of the violation rate associated with the wildlife loadings and/or because of any modifications that may have been made, that Phase 1of the implementation process will allow Dodd Creek to attain standards. The Commonwealth is investigating possibly changing the use of these waters or having a natural condition amendment added to their standards.

8) The TMDLs have been subject to public participation.

Four public meetings were held to discuss TMDL development on Dodd Creek. All of the public meetings were public noticed in the *Virginia Register* and subject to a thirty-day comment period. The first meeting was held on November 27, 2001 in Floyd, VA. Twenty-six people attended this initial meeting on the TMDL. Twenty-four people attended the second meeting which was held in Floyd, VA on February 26, 2002. Twenty-six people attended the third public meeting which was held on March 28, 2002 in Floyd, VA. Thirty-five people attended the fourth public meeting in Floyd, VA on June 25, 2002. Copies of the TMDL report were available for public distribution during the fourth and final meeting.